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ABSTRACT

This study tested the following hypotheses: (1) that children would use both verbal-associative and acoustic memory attributes when encoding words in memory, and that the recall of younger children would indicate dominance of the acoustic attribute while the recall of older children would indicate dominance of the verbal-associative attribute; (2) that there would be more rapid forgetting of the acoustic attribute during a delayed retention interval; and (3) that older subjects would evidence a higher degree of clustering of conceptually-related words and that younger subjects would produce a higher degree of clustering of rhyme-related words. A total of 284 third and sixth graders served as subjects. All subjects received the same treatment. Three word lists were developed, two of which were constructed with words whose relationship would reflect one of the memory attributes under investigation. The subjects learned and were tested on each of the three lists according to a standard free recall procedure. The results indicated that the subjects recalled conceptually-related and rhyme-related words significantly better than control words, and that children of elementary school age made use of these attributes in recalling organized verbal materials. (WR)

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A DEVELOPMENTAL STUDY OF THE EFFECT OF CONCEPTUAL AND ACOUSTIC SIMILARITY ON THE FREE RECALL OF VERBAL MATERIALS

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One important area of research which has contributed to the development of the present study is based on the theory of attributes of memory as proposed by Underwood (1969). In this theory memory is conceptualized as being composed of a number of attributes "which serve to discriminate one memory from another and to act as retrieval mechanisms for a target memory". There is evidence in support of this theory that meaningful verbal materials are encoded in memory with verbal associative memory attributes, whereas, less meaningful verbal materials are encoded with more primitive non-verbal associative memory attributes (Underwood, 1969). Included within the nonverbal associative attributes is the "acoustic" attribute which, in a verbal context, is the particular sound which is distinctive to letters, syllables, or words as a whole. The verbal associative attributes are defined as words which are not part of the task but which may be elicited implicitly as associates. In a line of experimentation involving these verbal associative attributes Wickens (1970) has investigated "encoding categories for words". One type of "meaning" dimension by which words can be encoded is taxonomic category, according to evidence collected by Wickens.

A number of experimenters using different procedures have investigated the effects of semantic and acoustic relatedness of words on the memory for these verbal materials (Underwood, 1965; Koeppel and Beecroft, 1967; and Forrester and King, 1971). Research findings have indicated that adult subjects use both semantic and acoustic encoding in the memory of words, but that the semantic attribute usually predominates over the acoustic. In studies of this type the semantic memory attribute usually consists of words which are coordinate associates of stimulus words or superordinate category names for the class to which several stimulus words belong. The acoustic memory attribute usually consists of similarity of rhyming sound.

Some experimentation has been performed to investigate the developmental changes which take place in memory attributes when children are used as subjects (Bach and Underwood, 1970; Felzen and Anisfeld, 1970; Ghatala, 1970). Generally, it has been found that the memory for words of younger children of about seven or eight years of age is dominated by the acoustic attribute, whereas, the memory for verbal materials of older children of about eleven or twelve years of age is dominated by the semantic attribute. These results suggest that the younger children have not yet developed the capacity to form implicit associative responses in the form of coordinate associations or superordinate class names.

Several experiments have also addressed themselves to the problem of differential forgetting of attributes over time (Bach and Underwood, 1970; Ghatala, 1970). Evidence collected from experimentation with children indicate that there is more rapid forgetting of the acoustic attribute than the semantic attribute over time.

Finally, some experimenters have demonstrated the presence of both semantic and acoustic clustering in the recall of words. Generally, they have found a tendency for semantic clustering to increase with the age of the subject (Bousfield, Esterson, and Whitmarsh, 1958; Wicklund, Palermo, and Jenkins, 1965; Bousfield and Wicklund, 1969; Forrester and King, 1971).

One purpose of the present study was to test the hypothesis that children would use both the verbal-associative and acoustic memory attributes when encoding words in memory and that the recall of younger children would indicate dominance of the acoustic attribute, while the recall of older children would indicate dominance of the verbal-associative attribute. Furthermore, it was hypothesized that, of the two attributes, there would be more rapid forgetting of the acoustic attribute during a delayed retention interval. Finally, it was hypothesized that older subjects would evidence a higher degree of clustering of conceptually-related words and that younger subjects would produce a higher degree of clustering of rhyme-related words.

Method

Subjects. A total of 284 elementary school children participated as subjects in this experiment. There were 142 subjects in each of two grade levels, the third and sixth grades. These subjects were selected from three elementary schools in two similar Connecticut communities. All subjects received the same treatments and, therefore, were not assigned to different experimental groups.

Materials. Three word lists were developed, two of which were constructed with words whose relationship would reflect one of the memory attributes under investigation. The three lists are presented in Table I. One list contained words which were conceptually related and a second list contained words which were related by rhyming sound. These lists were 12 items in length and contained three sets of four words each. A third control list contained 12 words which were unrelated.

It has been the practice in experiments of this type in which several groups of words are presented in a mixed list or in separate lists to equate all words in frequency and in word length. In this experiment it was decided that a more thorough control of words would provide a more valid indication of the effect of semantic and acoustic relatedness on recall. The dimensions for which the words were equated were frequency, concreteness, intensity, positive and negative valence, part of speech, and word length.

Using a word list developed for this purpose by Bloomer (1971), nouns were selected as the part of speech from which the three experimental lists would be built. From the total list of nouns a smaller list was constructed which contained words of moderate concreteness, moderate intensity, and moderate positive valence. Of this resulting list only words of high frequency, as determined by the Rinsland (1947) frequency count for school children, were retained. Finally, from this high frequency list, words of 3, 4, and 5 letters were chosen such that a nearly equal number of words of each length comprised each of the three lists. Moreover, the total number of letters was equated among lists with one exception--the list containing acoustically related words contained one more letter than the other two lists.

TABLE I

WORD LISTS ARRANGED BY TYPE OF WORD RELATIONSHIP

Conceptual	Acoustic	Unrelated
LAMP	PACK	HAY
CHAIR	TRACK	RIVER
TABLE	BACK	BALL
DESK	SACK	CORN
SUIT	TIN	TIME
COAT	PIN	ROPE
SHIRT	SKIN	TRUCK
HAT	CHIN	BOX
POT	STATE	OIL
DISH	GATE	PARTY
CUP	SKATE	TEETH
GLASS	SLATE	BOOK

For one of the experimental lists words belonging to the same concept category were selected from high frequency members of the category norms established by Battig and Montague (1969). For another experimental list sets of words having the same rhyming pattern were selected. The control list was similar to the two experimental lists in that it contained 12 words. Otherwise, the list contained words which were neither semantically not acoustically related. For all three lists, association norms (Bousfield, Cohen, Whitmarsh, and Kincaid, 1961; Palermo and Jenkins, 1964; Entwisle, 1966) were used to minimize the inter- and intralist interitem association strength.

Procedure. The subjects learned and were tested on each of the three lists according to a standard free recall procedure. The only variation in procedure involved the order of presentation of the three lists which was counterbalanced among subjects. Subsequently they were again tested for recall after a 24 hour delay. Responses bo both the immediate and delayed recall tests were scored for number of words recalled and for clustering of words related by semanti or acoustic similarity.

Results

The mean number of words recalled from each list and a mean index of clustering of words recalled were determined for each subject. This data was analyzed with a three-factor repeated-measures mixed analysis of variance design consisting of three variables: grade (3 and 6), type of word relationship (semantic, acoustic, and unrelated), and retention interval (immediate and 24 hours). Grade was considered to be a between-subjects variable because different subjects were run at the two grade levels. Type of word relationship and retention interval were considered to be within-subjects variables since within each grade level the same subjects experienced all three types of word treatments and both retention interval treatments.

Mean number of words recalled and the mean index of clustering were analyzed to determine the main effects of grade, type of word relationship, and retention interval and the interactions among these variables. Moreover, significant interactions were investigated in order to gain information on the simple effects of combinations of variables at each treatment level. Results associated with significant main and simple effects were further investigated with multiple comparison procedures in order to learn the exact nature of the differences found.

Recall Data

The mean number of words recalled, as a function of type of word relationship, grade, and retention interval, are presented in Table II. More words were recalled from lists organized according to conceptual and acoustic word relationship than from the list of unrelated words. The effect of type of word relationship was highly significant ($F = 62.13$, $df = 2/564$, $p < .001$). Post-hoc comparisons indicated that both conceptually-related and rhyme-related words were recalled significantly better ($p < .01$) than unrelated words. Moreover, the main effects of grade ($F = 67.10$, $df = 1/282$, $p < .001$) and retention interval ($F = 1129.82$, $df = 1/282$, $p < .001$) were also significant.

TABLE II

MEAN NUMBER OF WORDS RECALLED AS A FUNCTION OF WORD RELATIONSHIP, GRADE, AND RETENTION INTERVAL

	Conceptual	Acoustic	Unrelated
Immediate Recall			
Grade 3	6.96	7.59	5.06
Grade 6	8.89	8.51	7.85
Delayed Recall			
Grade 3	3.93	3.54	2.28
Grade 6	6.07	4.64	2.98
Total	6.46	6.07	4.79

The interaction of grade and word relationship was significant ($F = 5.93$, $df = 2/564$, $p < .005$), with sixth graders recalling more words than third graders for each type of word relationship. There was also a significant interaction between retention interval and word relationship ($F = 15.70$, $df = 2/564$, $p < .001$), with a decrement in word retention for all types of word relationship over the 24 hour retention interval.

The interaction of Grade Level x Retention Interval x Word Relationship was also significant ($F = 4.10$, $df = 2/564$, $p < .02$). For each type of word relationship, the mean number of words recalled for each retention interval and grade level combination are plotted in Figure 1. It is evident from an examination of the figure that in the immediate recall condition third graders recalled more rhyme-related than conceptually-related or unrelated words. Post hoc comparisons with the Tukey test indicated that both of these differences were significant ($p < .05$). In the immediate recall condition sixth graders, however, recalled more conceptually-related than rhyme-related or unrelated words, but post hoc comparisons revealed that only the difference between conceptually-related and unrelated words was significant.

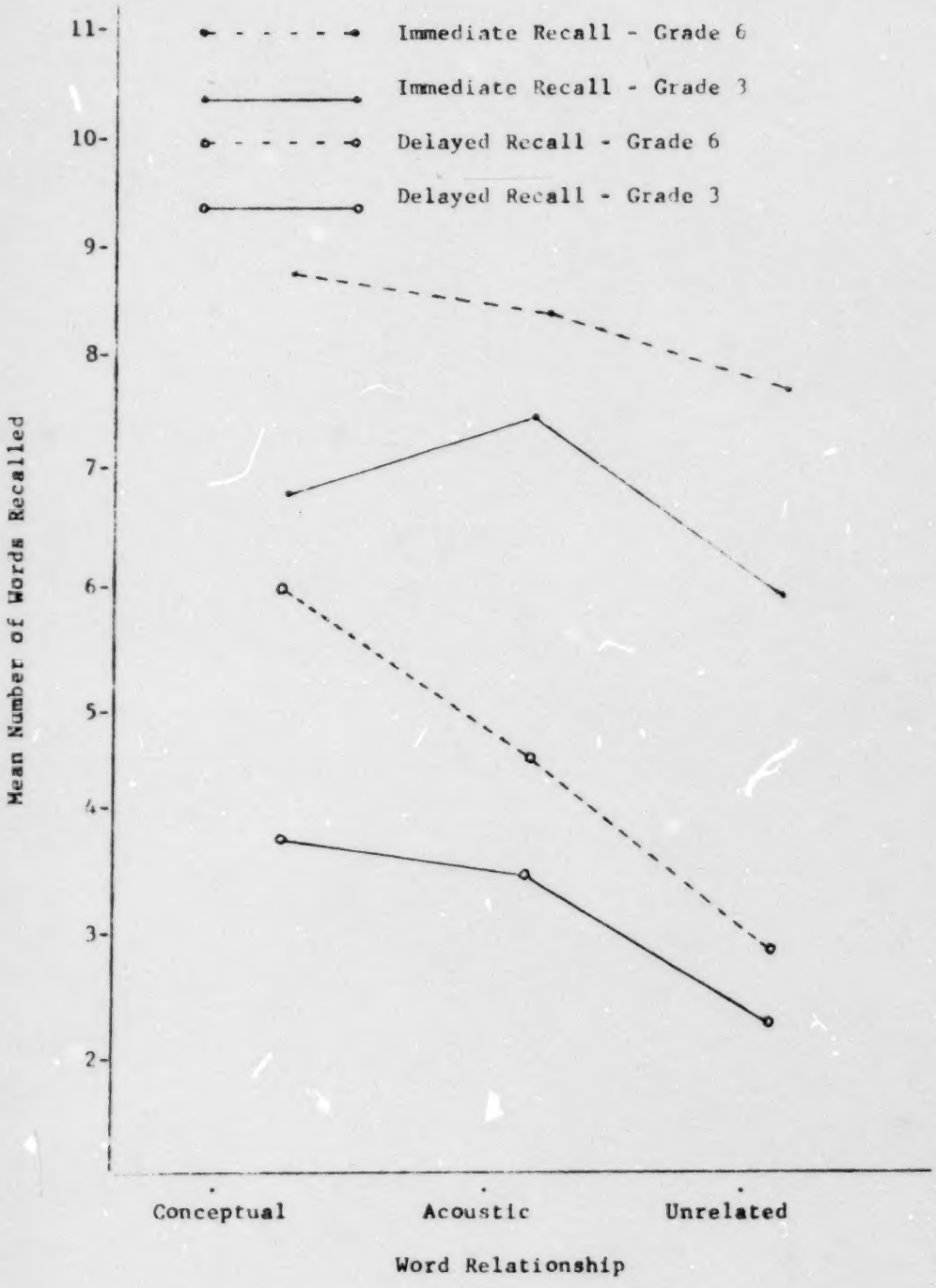

Figure 1. Frequency of words recalled by grade and retention interval as a function of word relationship.

A further examination of Figure 1 reveals that in the delayed recall condition both third and sixth graders recalled more conceptually-related than acoustically-related or unrelated words. Tukey post hoc comparisons indicated that for third graders only the difference between conceptually-related and unrelated words recalled was significant ($p < .05$), whereas, for sixth graders all differences were significant ($p < .01$).

Clustering Data

The analysis of the extent of clustering of related words was accomplished by making comparisons of the mean number of repetitions between the two types of word relationships of interest, namely, conceptual and rhyme relationship, under each of the experimental conditions. A "repetition" is a sequence of two words recalled from one category within a word list. The number of repetitions is the number of words from a category recalled together minus one (Bousfield, Whitmarsh, and Danick, 1958). Table III presents the mean number of repetitions for each type of word relationship considered, at each grade, and at each of the two retention intervals. An inspection of the table reveals that, for both grades and both retention intervals combined, the mean number of conceptuall-related and rhyme-related words clustered was very close, the difference being not significant.

TABLE III

MEAN NUMBER OF REPETITIONS AS A FUNCTION OF WORD RELATIONSHIP, GRADE, AND RETENTION INTERVAL

	Conceptual	Acoustic
Immediate Recall		
Grade 3	2.79	3.62
Grade 6	4.49	4.33
Delayed Recall		
Grade 3	1.11	1.36
Grade 6	2.77	2.11
Total	2.79	2.85

The interaction between grade and word relationship, however, was found to be highly significant ($F = 22.49$, $df = 1/282$, $p < .001$). For grades three and six, the mean number of words clustered for each type of word relationship and for both retention intervals combined are platted in Figure 2. The results presented indicate that third graders achieved a higher degree of clustering for rhyme-related words, 2.49, than for concept-related words, 1.95. An analysis of the effects of word relationship at this grade indicate the difference was statistically significant ($F = 14.26$, $df = 1/282$, $p < .001$). A further examination of Figure 4 indicates that sixth graders used a higher degree of clustering for concept-related words, 3.63, than for rhyme-related words, 3.22. An analysis of this difference at grade six indicated that it was statistically significant also ($F = 8.3$, $df = 1/141$, $p < .005$).

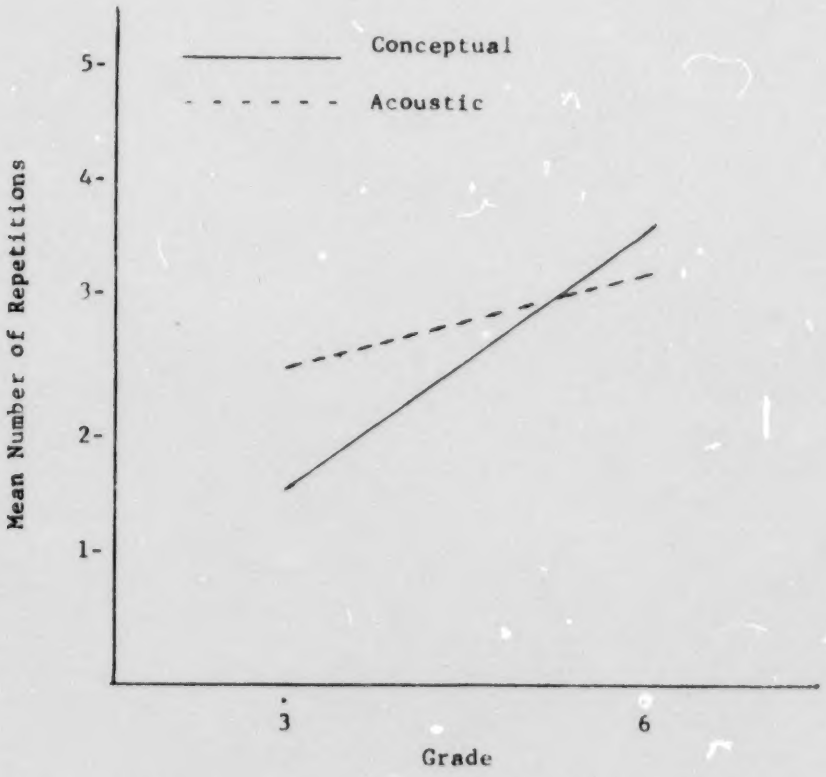

Figure 2. Frequency of repetitions by type of word relationship as a function of grade.

Discussion

The finding that all subjects recalled conceptually-related and rhyme-related words significantly better than control words led to the conclusion that children of elementary school age do make use of these attributes in recalling organized verbal materials. The presumption is that children will utilize the particular acoustic or semantic relationships as aids to recalling the words at a later time. The results of this study indicate that generally this presumption is correct. However, the findings also indicate that the conclusions must be qualified.

One purpose of the study was to investigate whether or not there was a difference in the attributes used by children of different ages. It was hypothesized that the recall of older children would be dominated by the conceptual attribute. The only finding consistent with this hypothesis was that third graders encoded words more successfully with the acoustic than with the conceptual attribute in the immediate-recall condition. While it is tempting to cite the fact that sixth graders encoded words more successfully with the conceptual than the acoustic attribute in the delayed-recall condition as further evidence for confirmation of the hypothesis, some evidence of differential rate of forgetting of the attributes over the retention interval casts some doubt on this application of the findings.

A further examination of recall data revealed that, across both grade levels, there was greater forgetting over time of verbal materials encoded in memory by means of the acoustic attribute than by means of the verbal-associative attribute. If, as the data suggests, the acoustic memory attribute is less stable over time, this may explain why third graders were not able to utilize this attribute as well for delayed recall as they were for immediate recall.

Moreover, it may explain why sixth graders, who utilized the verbal-associative and acoustic attributes equally well during immediate recall, were found to be more successfully utilizing the former attribute during delayed recall, thereby precluding the use of these findings to confirm the hypothesis that the recall of older children would be dominated by the verbal-associative attribute.

The clustering data provided results which were more consistent with the hypothesized differences between the two grade levels. These findings revealed that younger children clustered significantly more acoustically-related words, while older children clustered significantly more conceptually-related words than any other kind. These results are consistent with those in which adults have displayed significantly more clustering of conceptually related than acoustically-related words (Forrester and King, 1971) and college students have achieved a greater degree of associative clustering with conceptual categories than third or fourth graders (Bousfield, Esterson, and Whitmarsh, 1958). The results of the present study would seem to indicate that sixth graders, who clustered concept-related words more than rhyme-related words, behaved in a manner more characteristic of adults in this respect. This evidence suggests that by the sixth grade children have developed the ability to readily recognize subordinate instances of the same conceptual category and to utilize this cue in order to recall words, although, the results further indicate that they may also utilize other more primitive memory attributes to encode words in memory. This study does more clearly indicate that third graders have not yet developed this capacity to a high degree, but instead are more easily able to utilize the more primitive attribute of sound to relate words and to utilize this relationship for recalling them at a later time.

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